MINISTRY OF SUPPLY D.L.R.D./R.A.E.

VALVE ELECTRONIC **C.V.3986**

SPECIFICATION MOSA/CV.3986 incorporating MIL-E-1/188B ISSUE NO. 1 DATED 15.5.57 To be read in conjunction with K.1006.	SECURITY SPECIFICATION | VALVE

TYPE OF VALVE - Subminiature Double Triode with flying leads.

CATHODE - Indirectly heated.

ENVELOPE - Glass.

PROTOTYPE - 6021.

MARKING

See K.1001/4.

Additional Marking 6021

RATING
(All limiting values are absolute)

			NOTES
Heater Volts	(V)	6.3	
Heater Current	(mA)	300	
Max. Operating Anode Voltage	(V)	165	
Max. Anode Dissipation	(W)	0.7	A
Max. Negative Grid Voltage	(V)	55	A
Max. Peak Anode Current	(mA)	22	A
Max. Peak Grid Current	(mA)	5.5	A
Max. Heater-Cathode Voltage	(V)	200	
Max. Bulb Temperature	(°C)	220	
Typical Operating Conditions Note A.			
Anode Voltage	(V)	100	
Anode Current	(mA)	6.5	
Mutual Conductance	(mA/V)	5.4	
Amplification Factor		35	
Capacitances (pF)			
Cag (nom.)		1.5	A,B
Cin (nom.)		2.4	A,B
Cout (section 1) (nom.)		0.28	B
Cout (section 2) (nom.)		0.32	B
Ca' a" (max.)		0.52	B
Cg' g" (max.)		0.013	B

BASE

BS.448/B8D/F

CONNECTIONS

LEAD	ELECTRODE
1	Anode (2) a"
2	Grid (2) g"
3	Heater h
4	Cathode (2) k"
5	Cathode (1) k'
6	Heater h
7	Grid (1) g'
8	Anode (1) a'

DIMENSIONS (mm)

Dimensions	Min.	Max.
"A" Seated Height (mm)	-	34.92
"C" Dia.	9.3	10.16

NOTES

A. Each section.

B. Without screen.

CV3986

MIL-E-1/188B
23 August 1955
SUPERSEDING
MIL-E-1/188A
26 October 1954

INDIVIDUAL MILITARY SPECIFICATION SHEET

ELECTRON TUBE, RECEIVING, TWIN TRIODE, SUBMINIATURE

JAN-6021

This specification sheet forms a part of the latest issue of Military Specification MIL-E-1.

Description: Twin Triode, Medium Mu

Ratings:	Ef	Eb	Ec	Ebk	Rk/k	Rg/g	Ib/b	Ic/c	Pp/p	T Envelope	Alt
Absolute Maximums:	V 6.6	Vdc 165	Vdc 0	v 200	ohms ---	Meg 1.1	mAdc 22	mAdc 5.5	W 0.7	oC /220	ft 60,000 Note 2
Minimum:	6.0	---	-55	---	---	---	---	---	---	---	---
Test Cond.:	6.3	100	0	--- Note 1	150 Note 1	---	---	---	---	---	---

Cathode: Coated Unipotential
Base: Subminiature - 8 Pin with long leads

Diameter: 0.400 in. max.
Height: 1.375 in. max.

Envelope: T-3

Pin No.:	1	2	3	4	5	6	7	8
Element:	2p	2g	h	2k	1k	h	1g	1p

The following tests shall be performed:

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.
For miscellaneous requirements, see Paragraph 3.3, Inspection Instructions for Electron Tubes.

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	Limits Min.	LAL	Bogie	UAL	Max.	ALD	Units
	Qualification Approval Tests											
3.1	Qualification Approval:	Required for JAN Marking	---	---								
---	Cathode:	Coated Unipotential	---	---								
3.4.3	Base Connections:		---	---								
	Measurements Acceptance Tests Part 1, Note 3											
4.10.8	Heater Current:	Note 4	---	---	If:	---	288	300	312	---	24	mA
4.10.8	Heater Current:		0.65	II	If:	280	---	---	---	320	---	mA
4.10.15	Heater-Cathode Leakage:	Note 23 Ebk=+100Vdc Ebk=-100Vdc	0.65	II	Ihk: Ihk:	--- ---	--- ---	--- ---	--- ---	5.0 5.0	--- ---	uAdc uAdc
4.10.6.1	Grid Current:	Eb=150Vdc;Rk=300; Rg=1.0Meg;Note 23	0.65	II	Ic:	0	---	---	---	-0.3	---	uAdc
4.10.4.1	Plate Current(1):	Notes 4, 23	---	---	Ib:	---	5.6	6.5	7.3	---	2.3	mAdc
4.10.4.1	Plate Current(1):		0.65	II	Ib:	4.5	---	---	---	8.5	---	mAdc
4.10.4.1	Plate Current(2):	Ec=-6.5Vdc;Rk=0; Note 23	0.65	II	Ib:	---	---	---	---	100	---	uAdc
4.10.9	Transconductance(1):	Notes 4, 23	---	---	Sm:	---	5000	5400	5800	---	1100	umhos
4.10.9	Transconductance(1):		0.65	II	Sm:	4450	---	---	---	6350	---	umhos
4.7.5	Continuity and Shorts: (Inoperatives)		0.4	II		---	---	---	---	---	---	
4.9.1	Mechanical:	Envelope (8-1)	---	---		---	---	---	---	---	---	
	Measurements Acceptance Tests Part 2											
4.8.2	Insulation of Electrodes:	Note 23 (g-all) (p-all)	2.5	I	R: R:	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg

CV3986

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Sym.	Limits Min.	Limits LAL	Limits Bogie	Limits UAL	Limits Max.	ALD	Units
	Measurements Acceptance Tests Part 2 (Contd)											
4.10.4.1	Plate Current(1) Difference Between Sections:		2.5	I	Ib:	---	---	---	---	1.6	---	mAdc
4.10.9	Transconductance(2):	Ef=5.7V;Notes 22, 23	2.5	I	$\triangle \frac{Sg}{Kf}$:	---	---	---	---	15	---	%
4.10.6.2	Grid Emission:	Ef=7.5V;Ec=-7.5Vdc; Eb=150Vdc;Rk=0;Rg= 1.0Meg;Notes 23,24	2.5	I	Ic:	0	---	---	---	-0.5	---	uAdc
4.10.3.2	AF Noise:	Esig=65mVac;Rg=0.1Meg; Rp=.01Meg;Rk=75;Ck= 1000uf; Note 26	2.5	I	EB:	---	---	---	---	17	---	VU
---	Pulse Emission:	Ef=6.0V; e pulse=50v; tp=25usec; prr=200pps Notes 23, 25	6.5	1A	is:	300	---	---	---	---	---	ma
4.10.11.1	Amplification Factor:	Note 23	6.5	1A	Mu:	30	---	35	---	40	---	
4.10.14	Capacitance	No Shield;Note 23			Cgp:	1.2	---	---	---	1.8	---	uuf
		No Shield;Note 23			Cin:	1.8	---	---	---	3.0	---	uuf
		No Shield;Section 1	6.5	Code F	Cout:	0.20	---	---	---	0.36	---	uuf
		No Shield;Section 2			Cout:	0.22	---	---	---	0.42	---	uuf
		No Shield			Cgg:	---	---	---	---	0.013	---	uuf
		No Shield			Cpp:	---	---	---	---	0.52	---	uuf
---	Low Pressure Voltage Breakdown:	Pressure=55$\pm$5mm Hg; Voltage=300Vac; Note 6	6.5	Note 5		---	---	---	---	---	---	
4.9.20.3	Vibration(1):	No voltages;Post Shock and Fatigue Test End Points apply	10.0	Note 5		---	---	---	---	---	---	
4.9.19.1	Vibration(2):	Rp=10000;Ck=1000uf; F=40cps;G=15;Notes 7, 23	2.5	I	Ep:	---	---	---	---	50	---	mVac
	Degradation Rate Acceptance Tests Note 8											
4.9.5.3	Subminiature Lead Fatigue:	Note 9	2.5	Code F		4	---	---	---	---	---	arcs
4.9.20.5	Shock:	Hammer angle=30°; Ehk=$\pm$100Vdc;Rg=0.1Meg; Note 10	20	---		---	---	---	---	---	---	
4.9.20.6	Fatigue:	G=2.5;Fixed frequency; F=25 min, 60 max.	6.5	Note 5		---	---	---	---	---	---	
---	Post Shock and Fatigue Test End Points:	Vibration(2)	---	---	Ep:	---	---	---	---	200	---	mVac
		Heater-Cathode Leakage										
		Ehk=$\pm$100Vdc	---	---	Ihk:	---	---	---	---	20	---	uAdc
		Ehk=-100Vdc	---	---	Ihk:	---	---	---	---	20	---	uAdc
		Change in Transconductance(1) of individual tubes	---	---	$\triangle$ Sg:	---	---	---	---	20	---	%
---	Glass Strain:	Note 11	6.5	I		---	---	---	---	---	---	

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic 1st Sample	Allowable Defectives per Characteristic Combined Samples	Sym.	Limits Min.	Limits Max.	Units
	Acceptance Life Tests Note 8									
4.11.7	Heater Cycling Life Test:	Ef=7.0V; 1 min. on, 4 min. off; Ehk=140Vac; Ec=Eb=0;Note 12	2.5	Code H	---	---		---	---	
---	Stability Life Test; (1 hour):	Ehk=$\pm$200Vdc;Rg/g=1.0Meg; TA=Room;Notes 13, 26	1.0	Code I	---	---		---	---	
4.11.4	Stability Life Test End Points:	Change in Transconductance(1) of individual tubes	---	---	---	---	$\triangle$ Sg:	---	15	%

Ref.	Test	Conditions	AQL(%)	Insp. Level or Code	Allowable Defectives per Characteristic		Sym.	LIMITS		Units
					1st Sample	Combined Samples		Min.	Max.	
	Acceptance Life Tests Note 8(Contd)									
—	Survival Rate Life Test:	Stability Life Test Conditions or equivalent;TA=Room;Notes 14, 15	—	II	—	—		—	—	
4.11.4	Survival Rate Life Test End Points:	Continuity and Shorts (Inoperatives)	0.65	—	—	—		—	—	
		Transconductance(1)	1.0	—	—	—	Sm:	4000	—	umhos
4.11.5	Intermittent Life Test:	Stability Life Test Conditions;T Envelope=≠220°C min;Notes 16,17; 1000 Hour Requirements do not apply	—	—	—	—		—	—	
4.11.4	Intermittent Life Test End Points;(500 Hours): Note 16	Note 18								
		Inoperatives;Note 19	—	—	1	3		—	—	
		Grid Current	—	—	1	3	Ic:	0	-0.9	uAdc
		Heater Current	—	—	2	5	If:	276	328	mA
		Change in Transconductance(1) of individual tubes	—	—	1	3	Δ Sm: t	—	25	%
		Transconductance(2)	—	—	2	5	Δ Sm: Ef	—	15	%
		Heater-Cathode Leakage								
		Ehk=≠100Vdc	—	—	2	5	Ihk:	—	10	uAdc
		Ehk=-100Vdc					Ihk:	—	10	uAdc
		Insulation of Electrodes								
		g-all	—	—	2	5	R:	50	—	Meg
		p-all	—	—			R:	50	—	Meg
		Transconductance(1) average change	—	—	—	—	Avg Δ Sm: t	—	15	%
		Total Defectives	—	—	4	8		—	—	
4.11.5	Information Life Test: (1000 Hours)	Intermittent Life Test Conditions;Notes 17,20, 21								
	Packaging Information									
4.9.18.1.1	Carton Drop:	(d) Package Group 1; Carton Size C								

Caution to Electron Equipment Design Engineers. Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum envelope temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if absolute maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are directly related to the degree that regulation of the heater voltage is maintained at its center rated value.

Note 1: The reference point for heater-cathode potential shall be the positive terminal of the cathode resistor, unless otherwise specified.

Note 2: If altitude rating is exceeded, reduction of instantaneous voltages (Ef, excluded) may be required.

Note 3: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding Inoperatives and Mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective. MIL-STD-105, Inspection Level II shall apply.

Note 4: Variables Sampling Procedure:

Test for Lot-Average Acceptance:

Select a 35 tube sample at random from the lot. Number these tubes consecutively.

Determine the numerical average value of the characteristic specified on the specification sheet of the 35 tube sample. If this value is on or above the LAL and on or below the UAL, accept for Lot Average.

CV3986

Note 4: (Contd)

Test for Lot Dispersion Acceptance:
Divide the 35 tube sample into seven (7) consecutive sub-groups of five (5) tubes each. Determine the range, R, of each sub-group for the measured characteristic specified on the Specification Sheet.

Compute the numerical average of the R values which is equal to $\bar{R}$. If $\bar{R}$ is equal to or less than the ALD, accept for Lot Dispersion.

Note 5: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lot shall be subjected to this test. MIL-STD-105, sample size code letter F shall apply.

Note 6: There shall be no evidence of arcing or corona between anode pins and adjacent pins with no other voltages applied.

Note 7: For vibration tests, the impedance of the plate voltage supply shall not exceed that of a 40 uf capacitor at 10cps.

Note 8: Destructive tests:

Tubes subjected to the following destructive tests are not to be accepted under this specification.

4.9.5.3 Subminiature Lead Fatigue
4.9.20.5 Shock.
4.9.20.6 Fatigue.
4.11.7 Heater Cycling Life Test
4.11.5 Intermittent Life Test.

Note 9: When a manufacturer submits tubes for qualification approval, five extra tubes shall be submitted for lead fatigue testing. These may be electrical rejects.

Note 10: Leads may be clipped for application of voltages during impact.

Note 11: Glass strain procedures - All tubes submitted to this shall have been sealed a minimum of 48 hours prior to conducting this test. All tubes shall be at room temperature. The entire tube shall be immersed in water not less than 85°C for 15 seconds and immediately thereafter immersed in water not more than 5°C. for 5 seconds. The volume of water shall be large enough that the temperature will not be appreciably affected by the test. The method of submersion shall be in accordance with Drawing #245-JAN, and such that a minimum of heat is conducted away by the holder used. The tubes shall be placed in the water so that no contact is made with the containing vessel, nor shall the tubes contact each other. After the 5-second submersion period, the tubes shall be removed and allowed to dry at room temperature on a wooden surface. After drying at room temperature for a period of 48 hours, the tubes shall be inspected and rejected for evidence of air leaks. Electrical rejects other than inoperatives may be used in the performance of this test.

Note 12: The regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A failure or defect shall consist of an open heater, open cathode circuit, or a heater-cathode short.

Note 13: Stability Life Test:

a. Life test samples shall be selected from a lot at random in such a manner as to be representative of the lot. If such selection results in a sample containing tubes which are outside the initial specification sheet limits for the relevant life test end point characteristics, such tubes shall be replaced by randomly selected acceptable tubes.

b. Serially mark all tubes from the sample.

c. Record referenced characteristic measurements after a maximum operation of 15 minutes at specified voltage and current conditions on the entire sample.

d. Operate at life test conditions for one (1) hour (plus 30 minutes, minus 0 minutes). Life test shall be conducted as per paragraphs 4.11 and 4.11.5, MIL-E-1, except that the following shall be substituted for the third sentence of 4.11: The mean electrode potentials, except heater or filament, may be established at values differing by not more than 5% from the specified values provided the same average electrode dissipations are obtained that occur with the specified voltages. Fluctuations of all voltages including heater or filament voltage shall be as small as practical.

e. Record referenced characteristic measurements at the end of this test period. Referenced characteristic measurements shall be taken immediately following the test or tubes shall be preheated 15 minutes, under specified test voltage and current conditions, and immediately measured. The 15 minutes preheat shall be considered as part of the test time.

f. A defective shall be defined as a tube having a change in referenced characteristic greater than that specified on the specification sheet.

g. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown tests.

Note 14: MEANS OF ASSURING SURVIVAL RATE- The procedure for assuring the maintenance of a desirable quality level in terms of early life survival consists of a series of normal, reduced, and tightened inspection plans for use at 100 hours. The sample size is dependent upon lot size, and the tranfer between normal, reduced, and tightened inspection is dependent upon quality history.

The selection of inspection scheme and sampling plan shall be in accordance with Inspection Instructions for Electron Tubes paragraph 5.3.4.2 through 5.3.4.3.1.3 inclusive except that paragraph 5.3.4.2.2 shall be modified by deleting the last part of the first sentence which states "..... or if no lot in the last 20 lots inspected shall have been declared non-conforming for life test qualities." At the manufacturer's option, reduced inspection may be used if no lot in the last ten (10) lots inspected shall have been declared non-conforming.

Note 14: (Contd)

INSPECTION PROCEDURE

a. Select sample in accordance with Note 13, paragraph (a).

b. Tubes to be tested at 100 hours as provided in MIL-E-1(4.7.5). When any tap-short indication is obtained, the test shall be repeated. When any short indication is again obtained the tube will be rejected as an inoperative.

c. Determine the number of defective tubes at the 100 hour period.

d. If more than the allowable number of defectives occur, declare the lot non-conforming.

e. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown tests.

Note 15: For Survival Rate Life Test, the equivalent Stability Life Test conditions shall be interpreted as having the same heater voltage (Ef) and heater-cathode voltage (Ehk) as the Stability Life Test; and the same interruptions of MIL-E-1 paragraph 4.11.5 as the Intermittent Life Test. The electrode voltages shall be such that the element dissipations are not less than 80 percent, nor more than 100 percent of Stability Life Test Plate Dissipation. These voltages are to be maintained within the limits of plus 200, minus 50 percent of the Stability Life Test voltages.

Note 16: Intermittent Life Tests:

a. The first 20 tubes of the Stability Life Test sample which meet the measurements acceptance test limits for those characteristics specified as Intermittent Life Test End Points shall be used for the Intermittent Life Test sample. In the event that a second Stability Life Test sample is used, the first 20 tubes from that sample which meet the above conditions shall be used.

b. In the event of failure of the first sample on Intermittent Life Test, take a completely fresh sample (MIL-STD-105 sample size code letter I) and stabilize it in accordance with the conditions of the Stability Life Test. Then select from it the first 40 tubes which meet the measurements acceptance test limits for those characteristics specified as Intermittent Life Test End Points.
Subject these 40 tubes to the Intermittent Life Test. Acceptance shall then be based on combined results from the first and second samples.

c. As an alternate method, the manufacturer may select his life test sample as described in Note 13, paragraph (a).

d. Life test shall be conducted as per paragraphs 4.11, and 4.11.5, MIL-E-1, except that the following shall be substituted for the third sentence of 4.11: The mean electrode potentials, except heater or filament may be established at values differing by not more than 5% from the specified values provided the same average electrode dissipations are obtained that occur with the specified voltages. Fluctuations of all voltages including heater or filament voltage shall be as small as practical.

e. Regular Life Test

1. Regular Life test shall be conducted for 1000 hours.

2. Regular life test acceptance shall be on the basis of the 500 and 1000 hours requirements as indicated on Specification Sheet.

3. Regular life test shall be in effect initially and shall continue in effect until the eligibility criteria for the Reduced Hours Life Test have been met.

f. Reduced Hours Life Test:

1. Reduced Hours Life Test shall be conducted for 500 hours and acceptance shall be based on the 500 hour end point limits.

2. Eligibility for Reduced Hours Life Tests: No lot failure due to the 1000 hour life test has occurred in the preceding three (3) consecutive lots.

3. Loss of eligibility for Reduced Hours Life Test: Two (2) or more 500 hour life test lot failures occurring in the last three (3) consecutive lots.

g. The life test sample shall be read at the following times:

0 hours
500 hours (plus 48 hours; minus 24 hours)
1000 hours (plus 48 hours; minus 24 hours; when in force)

Additional reading periods may be used at the discretion of the electron tube manufacturer.

CV3986

Note 16: (Contd)

h. Acceptance Criteria: The lot shall be considered satisfactory for acceptance provided that the specified allowable defects are not exceeded and the change of the average of any characteristic in the life test sample specified for life test control of averages is not exceeded. The average percentage change shall be ascertained from the determination of the individual changes for each tube in the life test sample from the zero (0) hour value for the referenced characteristic or characteristics. For purposes of computation of this average percentage change, the absolute values of the individual changes for each tube in the life test sample shall be used. Any tube found inoperative during life testing shall not be considered in the calculation of this average.

i. A resubmitted lot must be subjected to all Measurements Acceptance Tests except Mechanical Inspection, Vibration, and Low Pressure Voltage Breakdown.

j. Not more than one (1) accidental breakage shall be allowed in the life test sample. In the event that one (1) life test tube is accidentally broken, acceptability of the life test sample shall be based upon the remaining tubes in the sample provided that the broken tube was not known to be a defective.

Note 17: Envelope Temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ring of .025 inch diameter phosphor bronze placed in contact with the envelope.

Note 18: Order for evaluation of life test defects.- If a tube is defective for more than one attribute characteristic, the characteristic appearing first in the life test end points shall constitute the failure.

Note 19: An inoperative as referenced in Life Test is defined as a tube having one (1) or more of the following defects: discontinuity (Ref. MIL-E-1, par. 4.7.1), shorts (Ref. MIL-E-1 par. 4.7.2) air leaks.

Note 20: On Information Life Tests, read same characteristics as Intermittent Life Test. Limits do not apply. Six copies of these data shall be forwarded to the Armed Services Electron Tube Committee upon request.

Note 21: This life test shall be conducted on a minimum of one sample of ten tubes each month of production. This sample shall be selected as the first ten serially marked, noninoperative tubes from a completed Intermittent Life Test sample. This life test shall be classified as a destructive test. Read at 1000 hours.

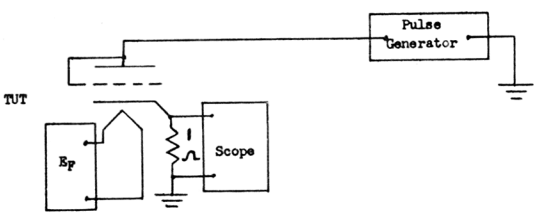
Note 22: Transconductance(2) is the percent change in Transconductance(1) of an individual tube resulting from the change in Ef.

Note 23: Test each section separately.

Note 24: Prior to this test tubes shall be preheated 5 minutes with both sections operating separately at conditions indicated below. Test within three (3) seconds after preheating. Three-minute test is not permitted. Grid Emission shall be the last test performed on the sample selected for the Grid Emission test.

Ef	Ec	Eb	Rk	Rg
V	Vdc	Vdc	ohms	Meg
7.5	0	150	500	1.0

Note 25: The pulse is essentially a square wave with 1.0 usec rise time and 0.8 usec fall. The pulse shall be applied to plate and grid tied together. Pulse emission shall be measured in terms of voltage developed across a 1.0 ohm resistor in the cathode circuit. Test limit as measured by the leading edge of a calibrated trace, the amplitude of the trailing edge of which shall not vary by more than 20 percent from the value of the leading edge. Test each unit separately.



Note 26: Tie 1k to 2k; 1g to 2g; and 1p to 2p.

Note 27: Reference specification shall be of the issue in effect on the date of invitation for bid.